



Research Newsletter

Responsive - Accessible - Relevant

A MESSAGE FROM THE RESEARCH DIRECTOR

By: Cameron Kergaye, PhD, PMP, PE

The Research Division held its annual workshop on March 28th where Ogden City Mayor Michael Caldwell delivered this year's UTRAC keynote address. Mayor Caldwell described the transportation and economic history of Ogden City from a major railroad junction to a progressive business community. At the workshop [58 research problem statements](#) were discussed and prioritized by 91 participants. New to UTRAC this year was the Utah Transit Authority as a research funding partner. On short notice, 12 problem statements were submitted to their Public Transportation breakout group.

Final determination of funding for UDOT's FY 2017 research projects will involve voting by the UTRAC council at the end of April and approval by FHWA by the end of June. While contracted work on these projects will not begin until July 1st, we expect a tentative approval to allow technical teams to begin early scope of work discussions.

The UTRAC Trailblazer award was presented to Tim Biel for his dedicated research on asphalt pavements and asphalt binder improvements. Tim worked for UDOT as the State Materials Engineer before becoming a consultant in 2008.

NCHRP's FY 2017 round of research projects will be determined very soon. UDOT ranked 59 of 117 submitted problem statements very high, and we are hoping that many of these will gain enough support for funding. Over the last few years, 14 problem statements submitted by UDOT have been funded, which has translated into \$6 million worth of NCHRP

research of interest to Utah.

FHWA and AASHTO have announced the seventh and final round of the SHRP2 Implementation Assistance Program. UDOT has already completed 2 of the 11 technical assistance opportunities it has successfully applied for. Information on the specific opportunities may be found [online](#). The deadline to apply is April 29.

Finally, the AASHTO Research Advisory Committee is currently voting on High Value Research, which designates recent research that has proven its implementation value. This year UDOT submitted two projects for consideration: Developing a Utah Bicycle and Pedestrian Counts Guidebook; and Correlation of Lab and Field Friction Measurements to Optimize Asphalt Aggregates.



L to R: Tom Hales, Scott Andrus, "Trailblazer" Tim Biel, & Nathan Lee

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Completed and Active Research Available at: www.udot.utah.gov/go/research

Editorial Staff: Joni DeMille jdemille@utah.gov and David Stevens davidstevens@utah.gov

Great Ideas from the 2016 TRB Annual Meeting

Based on past successes with the process, in January a group of sixteen UDOT leaders and engineers attended the [2016 Transportation Research Board \(TRB\) Annual Meeting](#) in Washington, D.C. to learn about the results of key transportation research and to network with others on best practices. Each UDOT attendee to the Annual Meeting brought back innovative, cost-saving ideas to implement at UDOT. In February this group attended the UDOT Leadership Team meeting to describe their implementation ideas.

Following is a list of many of the great ideas planned to be implemented at UDOT this year from the Annual Meeting:

- Safety as top criteria in project design
- "Share the Keys" teen driver requirements
- Red light running enforcement
- Work zone safety for pedestrians and cyclists
- Targeting efforts for areas of high pedestrian crash risk
- Wrong way driving countermeasures
- Tools to reduce animal-vehicle collisions
- Cost-benefit analysis and economic impact assessment in project evaluation and selection
- Scenario planning to assess disruptive technology impacts on travel demand and capacity
- Road user charge pilot
- ROW plans on demand
- Paperless system for encroachment inspections
- Dispute Resolution Boards
- Drones in work zones and inspection
- Alternative Technical Concepts in DBB projects
- Estimating traffic turning volumes in shared lanes using existing detection equipment
- Signal control considering pedestrian delay and vehicle throughput
- "Traffic Ticker" dashboard using real-time probe data
- Snowplow truck lighting
- Optimize RWIS placement and use in snow removal performance metrics
- Wash bays to reduce corrosion on snow removal vehicles
- Sensors in highway concrete and bridge decks

- Improving bridge transitions for better ride
- Anchored rockfall mesh on moderate slopes
- Uniformity and accessibility of soil and rock exploration logs
- Inverted pavements
- Develop a plan for maintaining Asset Management data
- Knowledge management in the Learning Management System
- Leadership training for all levels of supervision
- Innovation partnering through chambers of commerce
- Modernization of library technologies

In November 2016 those who attended the 2016 Annual Meeting will share their idea implementation progress with the UDOT Leadership Team. This summer UDOT leaders will compile a list of people from UDOT who they feel would benefit from attending the 2017 TRB Annual Meeting and help implement great ideas when they return. Those who are selected to attend the 2017 Annual Meeting will also be invited to attend the November leadership meeting to learn about the process.

We look forward to learning about the new implementation successes at UDOT. For more information, contact Cameron Kergaye (ckergaye@utah.gov) or David Stevens (davidstevens@utah.gov) of the Research Division.



Summary of Automated Traffic Signal Performance Measures Workshop in Salt Lake City

On January 26th and 27th, a workshop on Automated Traffic Signal Performance Measures (SPMs) was held in downtown Salt Lake City. The workshop was jointly sponsored by UDOT, Purdue University, Indiana Pooled Fund Study on SPMs, AASHTO, and NOCoE. In attendance were representatives from 20 state and federal agencies, 25 public agencies, 5 Universities, and 35 private-sector companies. In all, there were 169 representatives present from 85 agencies and 28 states, DC and Canada (Figure 1, Figure 2). Over the two days, 30 presentations were delivered by various speakers, including most of the agencies that have deployed the UDOT SPMs.

There was strong consensus from participants that there is an opportunity to further accelerate the implementation of traffic signal performance measures to reduce delay and increase mobility. This technology is applicable in both suburban arterial systems as well as urban areas. Proceedings of the Workshop are available here: <http://docs.lib.purdue.edu/atspmw/2016/>

UDOT has a state-of-the-art automated traffic signal performance measures system that allows all users access to various performance metrics. Such metrics include: approach volumes, lane-by-lane turning movement volumes, percent of vehicles arriving on green and red, the amount of green time used, etc. The website is accessible to all and can be found at: <http://udottraffic.utah.gov/signalperformancemetrics/>

UDOT has received national recognition by AASHTO, ITE, WASHTO, and others for our efforts in the performance measures. In turn, we have donated for free our source code to nine other agencies (and others pending) and helped them in getting up and running. UDOT's use of automated traffic signal performance measures have completely changed the way we manage our traffic signal program. Our decision making is now based on real-time feedback on how our system is actually operating. We no longer rely on public feedback, traffic counts on discrete days to reflect average conditions, or traffic models.

For more information, contact Mark Taylor of the UDOT Traffic Management Division at marktaylor@utah.gov.



Figure 1: Photo from opening session of Traffic Signal Performance Measures Workshop in Salt Lake City, UT on January 26, 2016.

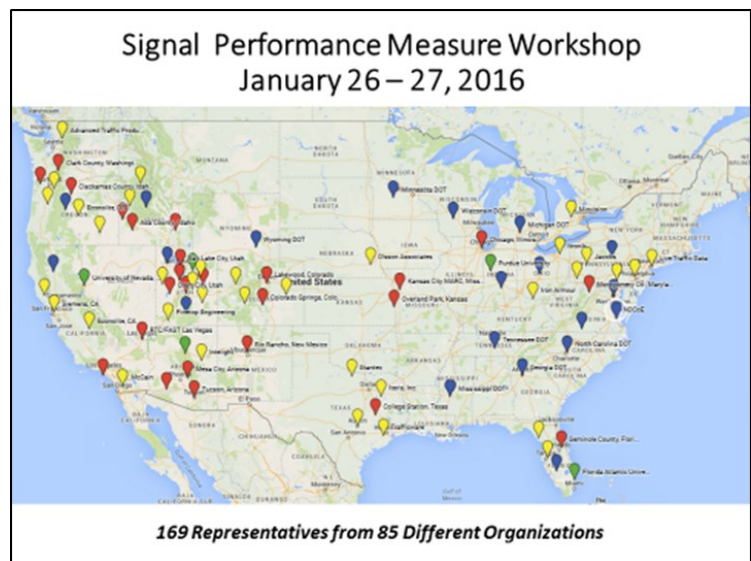


Figure 2: Map showing location of organizations represented at the Salt Lake City Traffic Signal Performance Workshop, Jan. 26-27.

Conducting Counts of Nonmotorized Transportation Users

Over the past five years non-motorized modes of transportation have become ever more prevalent on Utah's roadways. Historically, these modes have not been included in traffic counts nor are they accurately represented in the long range planning models used by UDOT and the MPOs. This exclusion creates an incomplete picture of both state and local transportation systems, making it difficult to evaluate facility usage.

Creating a Count Methodology

This research sought to create a structured approach for conducting non-motorized user counts, including which methods are most appropriate for conducting bicycle and pedestrian counts across Utah's diverse urban and rural environments. First, existing methods and technologies for counting non-motorized transportation users were identified and evaluated to determine their appropriateness and effectiveness in different environments and conditions. Second, interviews were conducted with local agencies who have experience conducting counts, and subject matter experts from around the country. Additional efforts included participating in national workshops and training webinars related to conducting non-motorized counts. Finally, validation data were collected at several local sites identified by the Technical Advisory Committee (TAC).



Micro Radar Installation on the Weber River Pathway

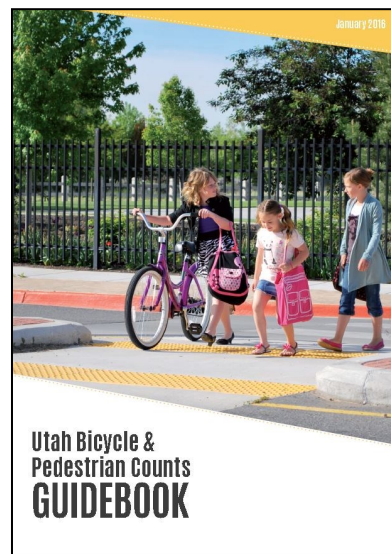
Testing New Technologies

UDOT currently has the capability to detect bicycle traffic at intersections using radar signal sensors. This technology has not been widely implemented nationally for the purpose of conducting non-motorized counts, but was seen as a promising

alternative considering it is already in place at a large majority of Utah intersections. Micro Radar, a newer technology which utilizes a puck sensor embedded in the pavement or parallel housing, was also tested at several local sites to determine its effectiveness for measuring non-motorized traffic.

The Utah Bicycle and Pedestrian Counts Guidebook

After evaluating all existing count methodologies and testing new potential methods, findings were summarized and compiled into a practical implementation guidebook. The guidebook is intended to educate local jurisdictions, government agencies, UDOT Region staff, MPOs, advocacy groups, or even members of the public on how to plan, prepare for, and conduct counts of non-motorized system users.



This comprehensive resource was created using the data gathered through the literature review, interviews, workshops/trainings and site testing conducted for this project. The creation of the Utah Bicycle and Pedestrian Counts Guidebook will allow diverse groups across the state to confidently prepare for and conduct counts using standard techniques that promote uniformity and ensure that data no longer goes to waste. The guidebook is available [online](#) with the research report on the Research Division website.

For additional information please contact Shaunna K. Burbidge, PhD burbidge@walkbikeplan.com or Tom Hales, PhD, SE thales@utah.gov.

Low-Temperature Cracking of Asphalt Pavements— Is a Solution in Sight?

Low-temperature cracking of pavements is a problem in cold areas of the country, including Utah. As the temperature drops, the pavement will contract resulting in cracks like the one shown on figure 1. Once a crack is formed, it will shorten the pavement life by allowing water and other materials to weaken the structure. Thousands of dollars are spent each year in maintenance activities related to low temperature cracking of asphalt pavements.



Figure 1: Cracked pavement surface

While the problem of low temperature cracking is well documented, until recently, there has never been a practical test for low temperature properties of asphalt mixtures. Existing low temperature tests take too long to provide results, require large quantities of materials, or are just too complex for mix design purposes.

With the support of UDOT, researchers at the University of Utah developed a test method using the Bending Beam Rheometer, BBR, to evaluate the low temperature properties of asphalt mixtures. The BBR is a device currently used to test asphalt binders for low temperature properties. The advantages of using this particular piece of equipment are many

and include: familiarity with equipment, short testing time, small quantities of material needed, and simplicity in the analysis. These would save thousands of dollars in equipment development and training. The test set up, shown on figure 2, was recently adopted as a standard AASHTO temporary specification TP-125.

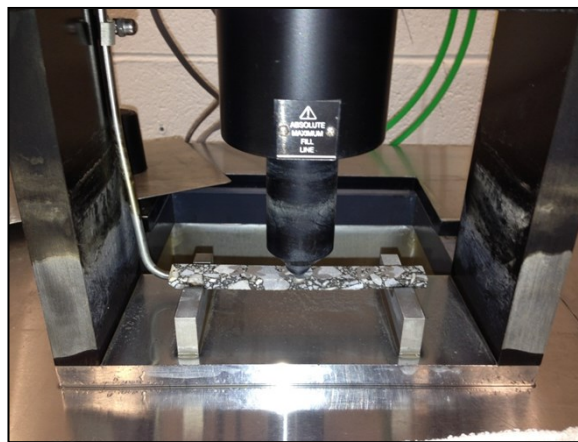


Figure 2: BBR Test setup for asphalt mixtures

The test is run at a control temperature that is related to the required performance grade for the specific location. It applies a constant load to a small beam, $\frac{1}{4}$ " x $\frac{1}{2}$ " x 4", and measures the deflection. Knowing the load and the deflection, the modulus of the material at 60-seconds and the rate of change in modulus, termed m-value, are determined in a manner similar to asphalt binder specifications. These two values are highly related to low-temperature performance of asphalt materials.

In developing this test, the first step was to ensure that the dimensions of the beam met the representative volume element requirements. Through both statistical and visual analysis, it was confirmed that the test setup could be used in mixtures with $\frac{3}{8}$ " nominal maximum aggregate size.

Once the laboratory analysis was established, the next step in developing this test was to ensure that the test results relate to actual pavement performance. Cores were obtained from seven projects right after construction and brought to the lab for testing in the BBR. Even though all projects were paved with the same asphalt binder grade, the test results resulted in mixes with widely different properties confirming, as expected, that asphalt binder properties, by themselves, are not enough to provide full characterization of asphalt mixtures.

Low-Temperature Cracking of Asphalt Pavements— Is a Solution in Sight? (cont.)

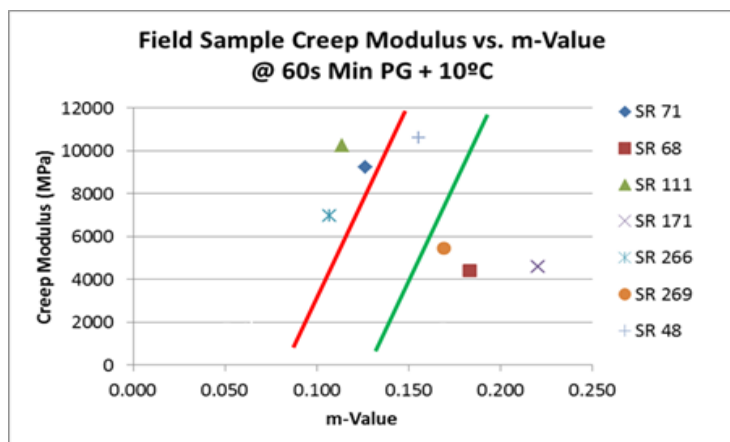


Figure 3: BBR results for field sections. Sections to the left cracked, sections on the right did not.

Based on these results, it was predicted that those mixtures with high modulus and low m-value would be likely to crack. After two winters the pavements were evaluated and three out of the four pavements with high modulus cracked and all of the pavements with low m-value cracked. Figure 3 shows a plot of m-value and modulus for the seven field sections evaluated.

Similar experiments have been repeated validating the results that both modulus and m-value are needed for a low temperature specification for asphalt mixtures. The fact that the test procedure has been standardized as a provisional AASHTO specification is encouraging and brings us one step closer to having a solution for low temperature cracking of asphalt pavements.

A report with the details on the development of this test can be found at UDOT's website: <https://www.udot.utah.gov/main/uconowner.gf?n=4493029359845211>.

Current research is evaluating the precision and bias of this test for single and multiple laboratories as well as determining realistic specification values to be used during mixture design.

Dr. Pedro Romero from the University of Utah is the PI for this project. He can be reached at romero@civil.utah.edu. Howard Anderson and Scott Andrus from UDOT Materials are the champions for this work. They can be reached, respectively, at handerson@utah.gov and scottandrus@utah.gov. The project manager for this contract is Kevin Nichol from UDOT Research who can be reached at knichol@utah.gov.



Online Information on UDOT's Active Research Projects

In recent months the UDOT Research Division has been using a new MS Access database to monitor the progress of several active research projects that we are managing. We appreciate all of Jesse Hill's efforts, in Program Development, to set up this database. Now we are pleased to be able to share various reports from the database with UDOT leaders and others regarding the status of our research program and projects.

The database provides a convenient place for each research project manager to enter and view information for active projects, such as the following:

- Project number and title
- Scope or objective
- UDOT champion and other panel members
- Consultant organization and researcher
- Contract number, amount, and start and end dates
- Funding type and sources
- Contract amendments
- Invoice payments
- Link to the project summary in TRB's Research in Progress (RiP) database
- Published report numbers
- Comments and next steps

The database includes research projects that were prioritized and funded through our annual research workshop (UTRAC) process, as well as a few other projects that were requested and approved by UDOT leaders. In the database we can also include information on

experimental feature evaluations, which are simpler studies in which we monitor performance of products in the field. Once a project is completed, the record is moved to the closed projects area of the database. Project close-out includes ensuring that the project final report is distributed to the UDOT Research website, TRB's TRID database for completed state and national transportation research, and a few other state and national databases and libraries.

One of the reports that we can generate from the research projects database is a Web Report. Recently we posted this report on active projects on our website, for use by UDOT division leaders and others to get an overview of the status of our research projects. Projects listed in the online report are sorted by contract/project end date. Information provided includes some of the items listed above. A snapshot of the online report is shown below. We plan to periodically update this online report as projects progress.

To access the Web Report of active UDOT research projects, we invite you to visit our website at <http://www.udot.utah.gov/go/research>. Then click on "Active Research" and "Active Research Projects".

For more information on active research projects at UDOT, see the link above and the names of the project managers on the Web Report, or contact Cameron Kergaye (ckergaye@utah.gov) or David Stevens (davidstevens@utah.gov) of the Research Division.

Contract Title	PIC	Champion	PM	Consultant	PI	Contract End Date	% Time Spent	% Money Spent	RIP Link
Probabilistic Liquefaction and Lateral Spread Hazard Mapping for Utah County	UT13.402	Jim Higbee	David Stevens	Brigham Young University	Kevin Franke	3/31/2016	97%	82%	http://rip.trb.org/view/2014/P/1398816
TPF-5(244), Shaking Table Testing to Evaluate Effectiveness of Vertical Drains for Liquefaction Mitigation	UT07.708	Jim Higbee	David Stevens	Brigham Young University	Kyle Rollins	3/31/2016	99%	35%	http://trid.trb.org/view/2013/P/1366542
Mechanistic Characterization of Soils and Aggregates	UT09.301	Steve Anderson	Jason Richins	Brigham Young University	Spencer Guthrie	4/1/2016	99%	47%	http://rip.trb.org/view/2011/P/1243528
Measuring Research Benefits	AM14.04	Cameron Kergaye	Kevin Nichol	Anderson Transportation Consulting, LLC	Doug Anderson	4/30/2016	94%		http://rip.trb.org/edit/1373255
Safe Driving Limits for Snow Plow Operations (Time Limits)	UT15.202	Kevin Griffin	Tom Hales	CTC & Associates LLC	Chris Kline	5/31/2016	62%	40%	http://rip.trb.org/view/2015/P/1398706
Evaluation of Finite Difference Approach to Estimating Consolidation Settlement	UT13.404	Grant Gummow	David Stevens	Brigham Young University	Clifton Farnsworth	6/30/2016	85%	33%	http://rip.trb.org/view/2014/P/1398818
Calibration of Automatic Performance Measures Speed and Volume Data	UT13.317	Mark Taylor	Kevin Nichol	Brigham Young University	Mitsu Saito	6/30/2016	89%	85%	http://rip.trb.org/edit/1373267

Introducing New Research Staff

Vincent Liu, P.E. has joined the Research Division as an Implementation Engineer. Vincent has over 22 years of UDOT experience. His main experience includes



working as a Method's Engineer in the Central Maintenance Division, working with Central Traffic & Safety and most recently with Region 2 Traffic and Safety. Vincent holds a Bachelor's Degree in Civil Engineering from the University of Utah. He earned his Professional Engineer license in 1997.

We're very pleased to welcome Vincent to the Research team and know he'll be a great asset to our customers and the Department. Vincent can be reached at vliu@utah.gov.



Spring is when you feel like whistling even with a shoe full of slush.

—Doug Larson

Colors are the smiles of nature.

—Leigh Hunt

The way to get started is to quit talking and begin doing.

—Walt Disney

RESEARCH CALENDAR OF EVENTS

BOOK DISCUSSION

Shane Marshall will host UDOT's next book discussion on Monday, April 18 from 11 AM to 12 PM in the Njord Conference Room at the Complex. The discussion will cover Principles 1-3 of Shawn Achor's book, *The Happiness Advantage: The Seven Principles of Positive Psychology That Fuel Success and Performance at Work*. Contact Joni DeMille (jdemille@utah.gov) to check out a print or audio copy of the book. Region employees can participate via video conferencing by advance arrangement with Joni.



RESEARCH FUNDING OPPORTUNITIES (click to see the full document)

Round 7 of SHRP2 Solutions Implementation Assistance Applications, DUE on April 29, 2016

NCHRP Project 20-7 Spring Submission Cycle Proposals, DUE on April 29, 2016

Panel Nominations for FY 2017 NCHRP Projects, DUE on May 6, 2016

University Transportation Centers Program, FY 2016 Grant Solicitation Applications, DUE on May 13, 2016

WEBINARS (Click to see webinar details)

Title	Day/Date	Time
Resistivity Measurements in Concrete (TRB)	Wednesday, April 13	12:00 PM -1:30 PM
Estimating the Life-Cycle Cost of Intersection Designs (TRB)	Tuesday, April 19	12:00 PM – 1:30 PM
Wrong-Way Driving: What We Know, What We Are Doing, and Where We Are Going (TRB)	Wednesday, April 20	12:00 AM – 1:30 PM
Transparent Best Value Selection Procedures (TRB)	Wednesday, April 27	12:00 PM – 1:30 PM
Roundabout Construction Plans and Specifications—Development and Application of Practices (TRB)	Tuesday, May 3	11:00 AM – 12:30 PM
Economic and Financial Dimensions to a Climate-Resilient Transportation Infrastructure (TRB)	Thursday, May 12	12:00 PM – 1:30 PM
Using Pavement Management System Data to Meet Agency Needs (TRB)	Monday, May 16	11:00 AM – 12:30 PM
Minimizing the Risk of Early-Age Cracking in Concrete (TRB)	Wednesday, May 25	12:00 PM – 1:30 PM
Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (TRB)	Thursday, May 26	12:00 PM – 1:30 PM
NON-ENGINEERING WEBINARS		
Refiring in All Areas of Your Life: Four Essential Strategies	On Demand	On Demand
How Can You Make Every Meeting More Productive	On Demand	On Demand
Influence at Work: What Gets in Your Way and What to Do About It	On Demand	On Demand